Implementing Decision Analysis and Resolution in a Software Organization

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How can the organization that develops [only] software, effectively apply the Decision Analysis and Resolution (DAR) process?

- DAR Unveiled: Software Engineer's View of the PA
- Implementing DAR
  - Examining current processes for analogs
  - A look at decisions we make – which are relevant?
  - Constructing the generic process
  - Defining the guidelines
- Benchmark validation
- Making it easy for the team -
  - DAR for the Software Engineer or Manager

Published Guidelines

- CMMI v1.1
- CMMI: Guidelines for Process Integration and Product Improvement (aka the Blue Book)
- CMMI Distilled: A Practical Introduction to Integrated Process Improvement (aka the Gold and Purple Book)
- Software Productivity Consortium (course, decision tool)
- Etc.

"*An organization can use DAR <u>for any significant decision</u> that needs to be made. Typically, employed for … technical decisions, such as those related to trade studies. DAR should not be used for making insignificant decisions, such as buying … pencils and paper ….*"

CMMI Distilled

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Purpose

"*The purpose of Decision Analysis and Resolution (DAR) is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.*"

i.e., a structured approach

- One specific goal: Evaluate Alternatives
  - SP 1.1-1 Establish Guidelines for Decision Analysis
  - SP 1.2-1 Establish Evaluation Criteria
  - SP 1.3-1 Identify Alternative Solutions
  - SP 1.4-1 Select Evaluation Methods
  - SP 1.5-1 Evaluate Alternatives
  - SP 1.6-1 Select Solutions

Staged – a Level 3 PA:
GG3: Institutionalize a Defined Process

Continuous:
GG1: Achieve Specific Goals
GG2: Institutionalize a Managed Process
GG3: Institutionalize a Defined Process
GG4: Institutionalize a Quantitatively Managed Process
GG5: Institutionalize an Optimizing Process

Applications of DAR

"…but, I'm a software development project, the trade studies have already been done!"

- Primary application:
  - Selected technical concerns, e.g., trade studies
- Other applications:
  - Selection among design or architectural decisions
  - Use of reusable components or COTS
  - Supplier selection
  - Make-buy decisions
  - Issues associated with medium to high risk on projects
  - …

"OK, there are other decisions we make…"

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DAR's Relationships to Other PAs

As noted by various cross References in the model

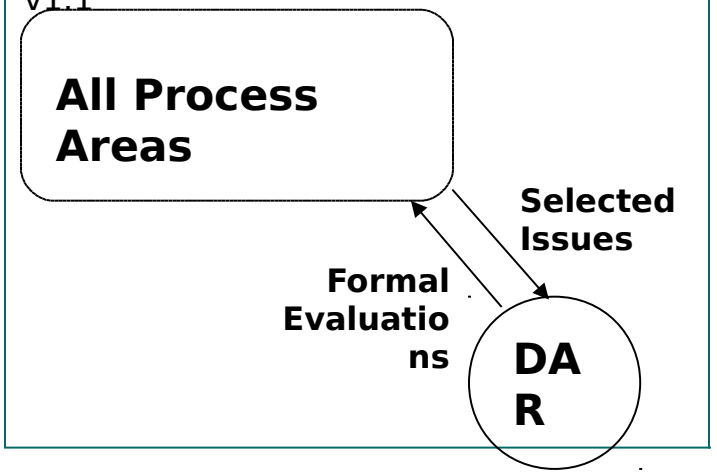
Decision Analysis and Resolution

It's a Subroutine!

- **Organizational Training**
- **Org Innovation & Deployment**
- **Project Planning**
- **Supplier Agreement Mgmt**
- **Integrated Project Management**
- **Risk Management**
- **Integrated Supplier Mgmt**
- **Technical Solution**
- **Product Integration**
- **Org Environment for Integration**

An Advanced (or Progressive) Support Process Area

"The advanced Support process areas provide the projects and organization with an advanced [improved] support capability. Each of these process areas relies on specific inputs or practices from other process areas." [FM102.HDA105.HDB103.T101] CMMI v1.1



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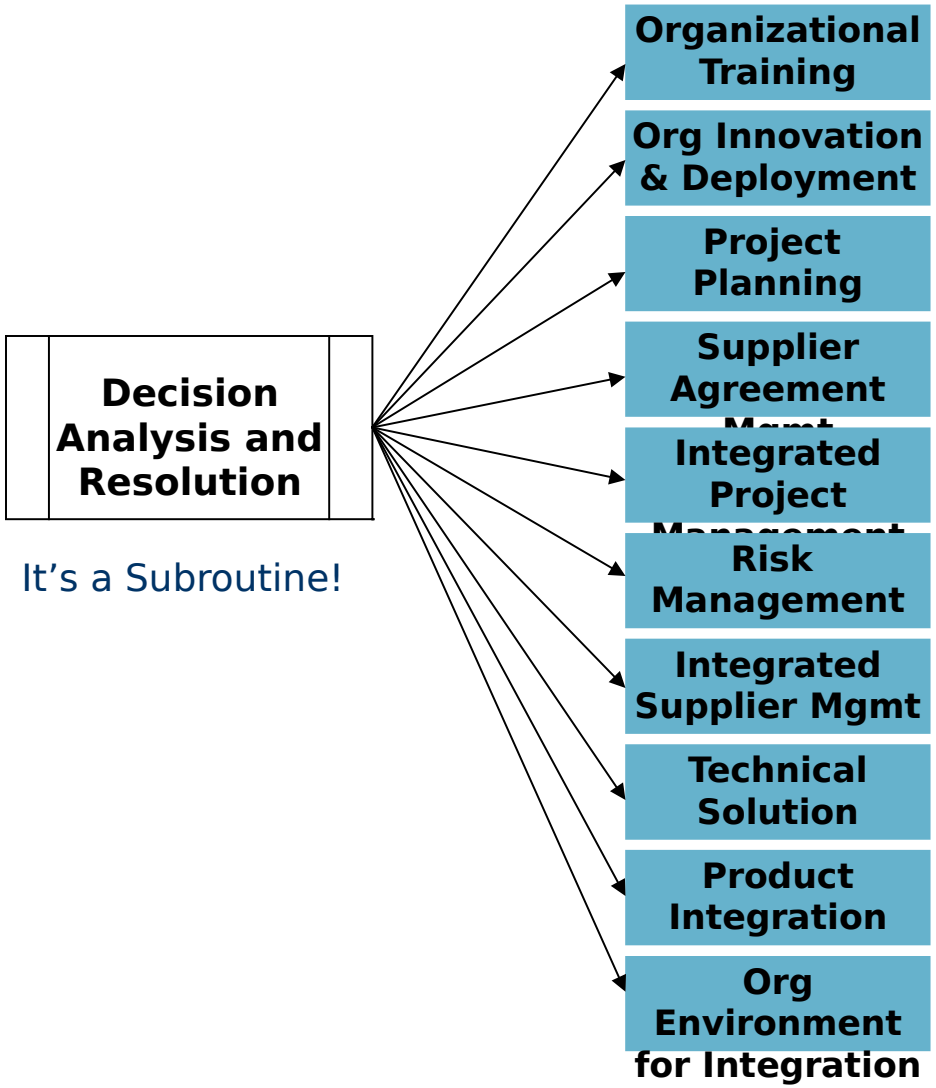
DAR's Relationships to Other PAs



It's a Subroutine!

But, I'm a software development project, with no subcontractors, and we're not using IPTs, so I can eliminate:

Supplier Sourcing discipline

Integrated product and process development discipline

DAR's Relationships to Other PAs

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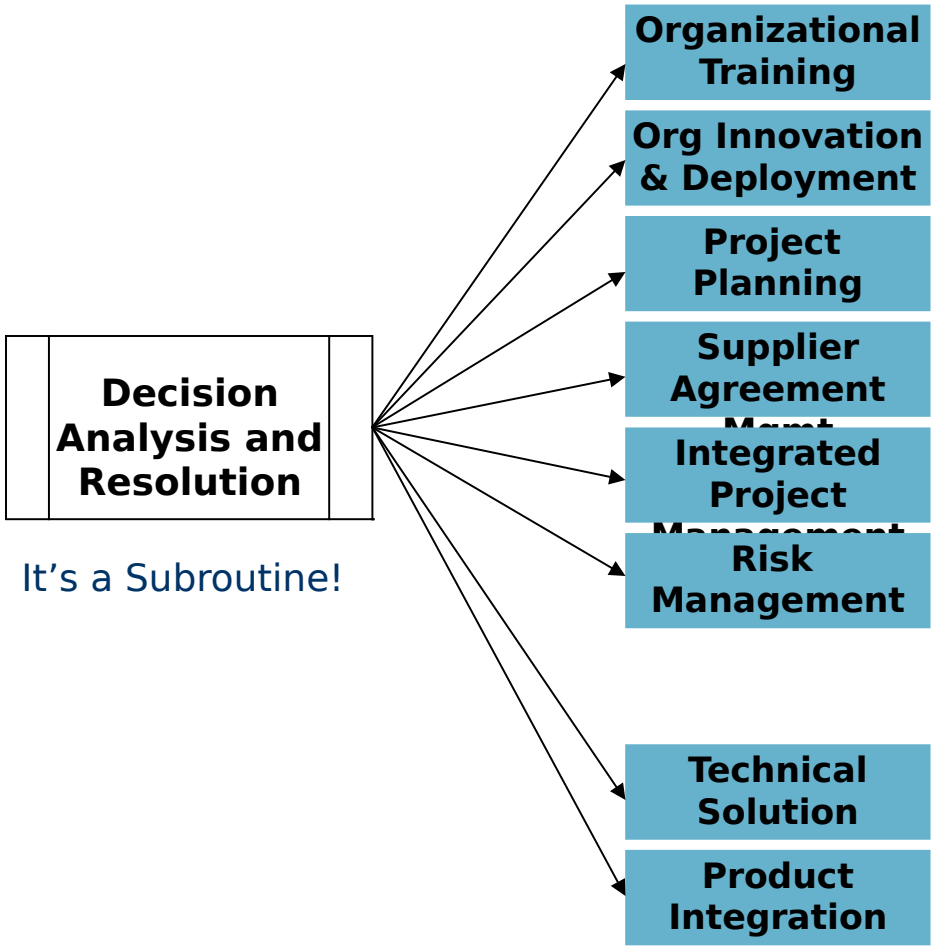

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DAR's Relationships to Other PAs

Decision Analysis and Resolution

It's a Subroutine!

Organizational Training

- Refer to DAR for how to apply decision-making criteria when determining training approaches or developing training materials.

Org Innovation & Deployment

- Refer to DAR for formal evaluations related to improvement proposals and innovations.

Project Planning

- Refer to DAR to address planning issues
- Apply appropriate planning to formal DARs

Supplier Agreement Mgmt

- Refer to DAR for information about formal evaluation approaches that can be used to select suppliers

Integrated Project Management

- Ensure the project's defined process includes a DAR process and guidelines for use
- Apply DAR to project issues

Risk Management

- Refer to DAR for information about formal evaluation approaches to evaluate alternatives to mitigate risk

Technical Solution

- Refer to DAR for information about establishing criteria and alternatives and performing formal evaluations

Product Integration

- Refer to DAR for information about integration sequence, procedures and environment establishment

Program Context

- Large software development program
  - System design, software requirements are received from the client
  - Program implements high level design, constructs software, completes unit test and inter-component integration
  - Software is delivered to the client for system integration
  - Successive releases about 80% reuse, 20% new
  - Ongoing technology refreshment
  - Majority of the development platform and infrastructure is dictated by the client via contract
- Ongoing for 25+ years
- Level 5, SW-CMM, since 2001 (Level 4 since 1998)

Many technical concerns addressed by the client, but there are other opportunities for DAR

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We Make Lots of Decisions Every Day…

Should we develop the training or select a vendor?

Which risk mitigation strategy is best?

Which risk tool should we use?

Do we replan functional content, or adjust schedule?

Time to get new laptops?

Is this a BID or NOBID new business opportunity?

Should we rearchitect this module?

Which consultant should we hire?

How should we reward the staff for outstanding award fees?

Should we move to a parametric cost model? Which one?

We have procedures to cover many of these … where does DAR apply?

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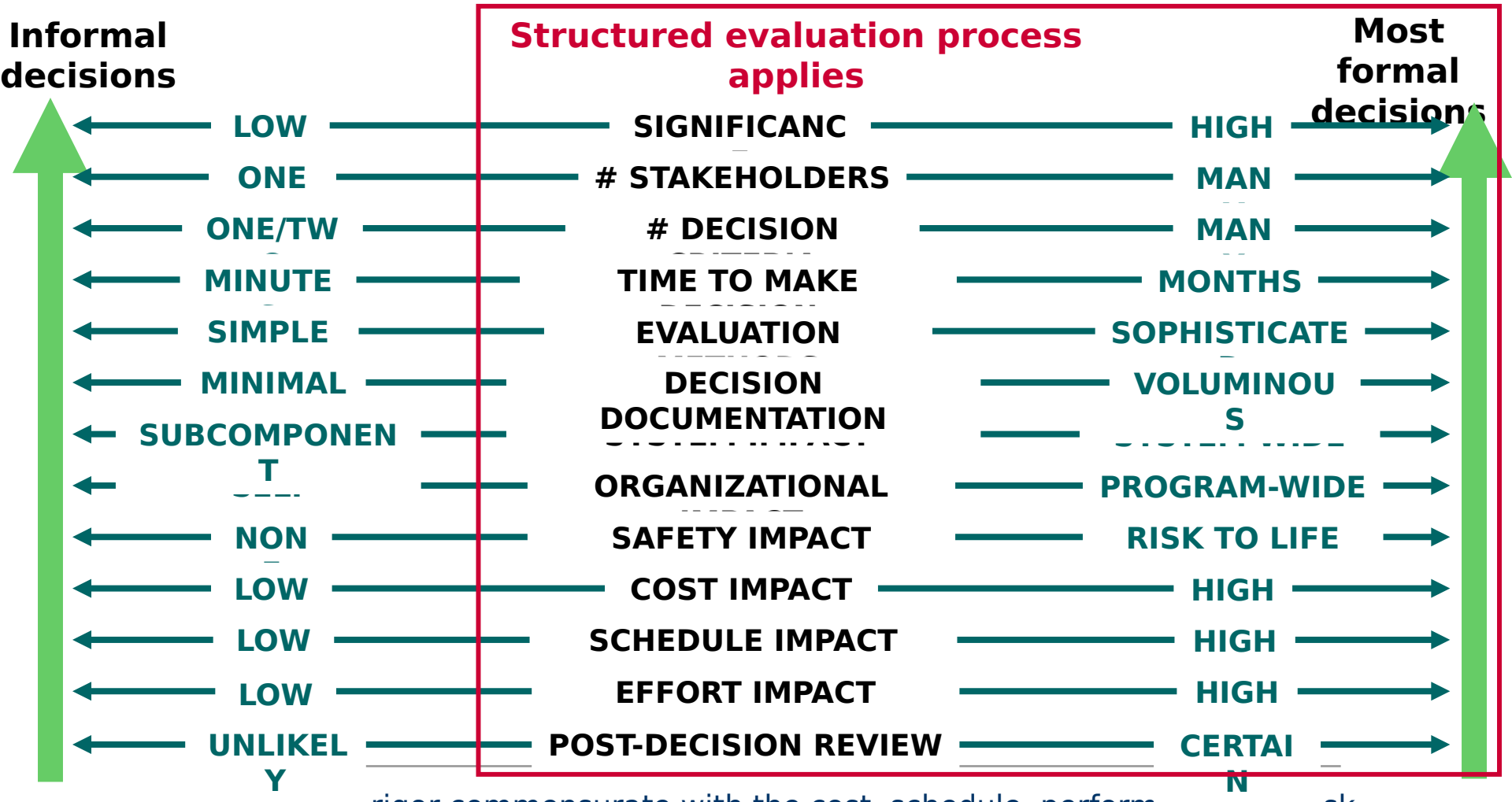
We characterized decisions along a continuum…



Degree of rigor commensurate with the cost, schedule, performance and risk impact of the decision

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We examined the existing processes for DAR analogs…

Organizational Training	Training Procurement	DAR – like subprocess	• Make/buy training • Appropriate training?
Org Innovation & Deployment	Technology Change	DAR – like subprocess	• Technology refreshment • Process change pilots
Supplier Agreement Mgmt	Subcontractor Selection	DAR – like subprocess	• Selection of consultants
Risk Management	Risk Management	DAR – like subprocess	• Selection of risk mitigation strategies
	Business Opportunity Assessment	DAR – like subprocess	• Bid / No Bid Decision

We found many cases where we'd implemented the subroutine 'in-line'

We reviewed each subprocess, and ensured it met the DAR goals

… are these DAR?

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And examined more existing processes for DAR analogs…

We also found cases where the decision process was hard-wired into the process definition or automated workflow

Peer Review Selection	Hardwired DAR subprocess

- **Issue:** When and which type of peer review to conduct?
- **Guidelines:** Defined as part of the development workflow process
- **Criteria:** Examine size, degree of change impact, risk to system
- **ID Alternatives:** Predefined based on values against criteria

  Walkthru vs full Fagan-like inspection
- **Evaluation Method:** Gather criteria data values and assess
- **Evaluate Alternatives:** Done historically, selection based on values
- **Select Solutions:** Decision path based on values against criteria
- **Generic Processes:** Build into the review procedures

- 10 years ago this was a dynamic process
- Review rigor options were more dynamic
- Process improvement cycles have narrowed this process down to two best options based on study that determined dependent variable criteria
- Defined implementation and criteria for execution are defined as part of the development workflow
- An embedded, codified decision-tree

… is this DAR?

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We also defined a generic DAR process

DEFINE THE ISSUE TO BE RESOLVED

- Specify the problem
- Capture key data
- Capture constraints

ASSIGN A LEAD AND PLAN THE EFFORT

- Identify a trained Lead
- Review the issue
- Build the initial plan

ESTABLISH EVALUATION CRITERIA

- Define evaluation criteria
- Define ranking scale
- Rank criteria
- Document criteria

IDENTIFY ALTERNATIVE SOLUTIONS

- Capture alternative solutions
- Perform a literature search
- Solicit stakeholders
- Document alternatives

SELECT EVALUATION METHODS

- Select evaluation methods
- Document the selection

EVALUATE ALTERNATIVES

- Perform the evaluation
- Consider new alternatives
- Document results

SELECT SOLUTION

- Assess risks of solutions
- Select high score/low risk
- Gain approval
- Document

CAPTURE RESULTS AND ARCHIVE

- Consolidate documents
- Archive

- Process documented in a detailed implementation procedure
- Fully scalable (least to most formal)
- Includes selection of evaluation methods
- Developed and deployed training

And guidelines for use …

Execution of the formal DAR process is required when:

- A cost impact greater than $xx to overhead or capital budget, or unrecoverable contract cost, is anticipated, or
- Risks that impact schedule or resource expenditures that cannot be recovered within that applicable business cycle or affects the projects ability to achieve a commitment, or
- The decision may result in loss of business, or
- The decision involves significant safety issues or possible loss of life, or
- Planned decision points are built into the program schedule around known or anticipated issues, or
- When directed by executive management or the Program Manager.

Guidelines documented in the Program Management Plan

Guidelines defined applied [mostly] to significant organizational decisions

And considered some decision support tools…

- Software Productivity Consortium Toolkit templates
- Software Productivity Consortium Decision Model Tool
- Expert Choice
- Logical Decisions
- Criterium DecisionPlus
- DecisionPro
- WinQDB
- Risk+
- @Risk

• Generally formalize the process of selecting criteria
• Enable you to quantify and weight ranking criteria
• Can be useful if you are doing similar DARs in a short period of time
• Some cost money, some are free (or free to members)
• Decided we didn't need to select a tool at this time

Decision tools can help but are not required

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And developed a DAR Worksheet.

Defines issue, task, responsible individual(s)

FDAR Lead:	**Email:**		
Telephone:	**FDAR Repository:**		
Responsible (Chartering) Manager:	**Telephone:**		
FDAR Scope:			
FDAR Constraints:			
FDAR Formality: ___ Informal ____ Formal **FDAR Size:** _____ Small or Medium ___ Large **Configuration Management Method:**	**Staff Months** **Cost**	**Estimated**	**Actual**
FDAR Start Date:	**FDAR Completion Date:**		
FDAR Plan Approver:	**Approval Date:**		
Indicate Required FDAR Reviews:	❑ Initial Plan Review ❑ Alternative Solutions Stakeholder Review ❑ Evaluation Method Stakeholder Review ❑ Select Solutions Stakeholder Review		
Indicate Required Metrics:	❑ Cost ❑ Effort ❑ Evaluation Criteria Churn ❑ Review Actions Opened / Closed / Late ❑ Criteria ranking ❑ Solution Scores		
Indicate Additional Resources Required:	❑ _____		
Stakeholders	**Role**		

Points to where results are archived

PROCESS EXECUTION ARTIFACTS:

FDAR Process Step	
Chartering event record, FDAR plan and schedule and periodic reports	
SP1.2 Selected decision making technique(s)	
SP1.3 Selected evaluation criteria	
SP1.4 Identified alternate solutions	
SP1.5 Evaluation of alternative solutions	
SP1.6 Selected solution	
Itemized list of supporting materials, contacts, vendors, etc.	
End-Item Recommendation and Management brief	

Capture and archive a minimum set of information

The Litmus Test: SCAMPI B

- DAR Implementation Strategies:
  - Hard-wired
  - In-line subroutine
  - DAR procedure – known issues, planned decision points captured in projects' Software Development Plans
  - DAR procedure – unforeseen issue, dynamic selection based on guidelines
- Training
  - Developed and deployed initially to senior management and technical staff
- Artifacts provided:
  - Project level: limited to hard-wired, in-line examples
  - Organizational level: DAR procedure execution
  - Limited DAR procedure execution

Did we formalize enough of our decision-making?

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The Litmus Test: SCAMPI B – FEEDBACK!

- DAR Implementation Strategies:
  - X Hard-wired — **Team didn't feel this met the intent of the PA**
  - X In-line subroutine — **Team also felt this was too tailored to be considered DAR**
  - ✓ DAR procedure – known issues, planned decision points ← **Clean implementation of the process**
  - ✓ DAR procedure – unforeseen issue, dynamic selection ← **Clean implementation of the process**
- Training
  - ✓ Developed and deployed
- Artifact evidence:
  - X Project level: limited to hard-wired, in-line examples — **Mid-significance decisions throughout project need DAR**
  - ✓ Organizational level: DAR procedure execution
  - Limited DAR procedure execution

Mid-course correction indicated

Next Steps

- Simplify DAR implementation for non-organizational level decisions
  - Worksheet =>2 pages, provides explicit guidance (provide checkboxes for options in each process step)
  - Elaborate guidelines at project level
  - Provide more explicit, relevant examples
  - Update training, expand target audience
- Incentivize mid- and junior-level managers, senior technical staff to increase participation
- Normalize the DAR embedded ‘subroutine’ implementation
  - Review in-line subroutine implementations
  - Consider value of removing customized, embedded implementation, and invoking ‘subroutine’, if appropriate
  - E.g., Technology Change revisions are underway as part of CMMI transition

DAR applies across many processes, across the organization

Revised DAR Worksheet

Defines issue, task, responsible individual(s)

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Indicate Additional Resources Required:	❑ _____		
Stakeholders	**Role**		

Captures selections and results

Triggering Event:

List evaluation criteria: (Supply values where deterministic, rank 1..x, 1 most important)

❑ Time Limit:	❑ Resource Limit::	❑ Effort Limit:
❑ Technology Limitations:	❑ Environmental Impact::	❑ Risks:
❑ Other:	❑ Other:	❑ Other:

Evaluation Method(s) applied: (Select all that apply)

❑ Simple (Pair-Wise) comparison	❑ Simulation	❑ Probabilistic model
❑ Decision tool	❑ Trade Study	❑ Cost Study
❑ Business Opportunity Study	❑ Extrapolation based on pilot or prototype	❑ Extrapolation based on other known work
❑ Testing	❑ Data Comparison	❑ Feature Comparison
❑ User review and comment	❑ Expected Value	❑ Monte Carlo
❑ Linear Programming	❑ Design of Experiments	❑ Group techniques
❑ Other:	❑ Other:	❑ Other:

New tool or technology required? ❑ Yes ❑ No

Alternatives generated by:

❑ Literature search	❑ Stakeholder solicitation	❑ Brainstorming session
❑ Working Group	❑ Subject Matter Experts	❑ Other:

List alternate solutions being considered:

1.
2.
3.
4.

Identify selected solution number:

Rationale for selection:

List known risks from implementing selected solution: (Risks to be tracked and mitigated)

❑
❑

Documentation from this decision:

❑ DAR Worksheet	❑ DAR Worksheet only	❑ White Paper
❑ Trade Study	❑ Slide Presentation	❑ Other report
❑ Executive Discussion / Brief	❑ Other:	❑ Other:

Configuration Management of DAR Worksheet and supporting artifacts:

• Version Control	• Folder Management
• CM Organization required?	• Identify Folder:

Capture and archive a minimum set of information

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Improved Guidelines

If

- # Stakeholders =1
- Time to make decision = <60 minutes
- System Impact = subcomponent
- Organizational Impact = Self
- Effort Impact <1 staff day
- Manager sign-off not required

Then don't DAR

Else

DAR candidate

Adjust formality level

Situational Triggers = DAR Opportunities

Management

- Replanning trade-offs (cost, schedule, content)
- Reorganization
- Facility moves
- Work Assignment options
- Non-billable expenditures > $100
- Opportunity pursuit (Step Reviews), Bid/NoBid

Technical

- Design rearchitecture after initial approval or of existing design/code
- Implementation options
- Integration strategies (order, content, environment)

IT Department

- Upgrades to IT infrastructure
- Who gets the upgraded technology

Etc.

The Bottom Line

DAR has many applications beyond technical decisions

- You may find you've implemented DAR 'in-line' already!
  - Must ensure 'in-line' implementation fully maps
  - Must clearly show relationship to the team
- Even if you're only constructing software, there will likely be occasions where significant technical decisions will be made (development team, test team, IT support, management planning)
- Define a robust, generic procedure (scales low => high formality)
- Provide guidelines that apply across the organization
  - Easy to define guidelines for the most formal, significant decisions that impact the whole program or organization
  - Slightly trickier to define guidelines for the mid-significance decisions where DAR applies, but staff is reluctant to take the time to capture (real examples critical!)

Software Development Organizations do DAR, in many ways!

Experience. Results.

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